

***Margaritaria* (Phyllanthaceae), a new generic record for the Singapore flora**

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ABSTRACT. The Warren Golf Club in south-central Singapore, established in 1962 and sandwiched between Dover Road and the Ayer Rajah Expressway (AYE), retained some tree stands that could have unwittingly served as a refugium for some forest species before it was relocated elsewhere in 2000 to make way for the development of University Town, or UTown, an extension of the National University of Singapore. At this locality, *Margaritaria indica*, a new genus and species record for Singapore, was discovered. The distribution, rarity, and conservation status of this taxon for Singapore and Peninsular Malaysia are discussed.

Keywords. *Margaritaria*, new genus record, Peninsular Malaysia, Phyllanthaceae, rare plant, Singapore

Introduction

Singapore is an island nation located in Sundaland, one of the world's richest biodiversity hotspots. This floristically diverse region also includes Brunei, Indonesia, and Malaysia, and is estimated to harbour about 25,000 species of plants (Myers et al., 2000). Singapore's land area as of 2013, taking into account some land reclamation, is more than 715 km² (Department of Statistics, Singapore, 2014; Chou, 2011). In a recent enumeration of Singapore's total flora by Chong et al. (2011) they recorded 4173 species, of which 2141 species are native to the island. Tan (2008) indicated that close to 89% of Singapore's native flora requires immediate conservation attention in the remaining forest reserves of Singapore.

As NParks, the National University of Singapore (NUS) and other local tertiary education institutions, as well as non-governmental organisations (NGOs) such as the Nature Society (Singapore), continue to monitor the present flora of Singapore, many new and exciting discoveries have come to light, including the rediscovery of taxa once thought extinct. Several recent examples are *Ampelocissus ascendiflora* and *A. thyrsiflora* (Vitaceae) (Yeo et al., 2013); *Ficus stricta* (Moraceae) (Yeo et al., 2012); *Marsdenia maingayi* (Apocynaceae) (Yeoh et al., 2013); and *Vrydagzynea lancifolia* (Orchidaceae) (Lim et al., 2014).

The new genus and species record highlighted in the present paper illustrates how a tree-conservation enactment was able to protect a rare taxon despite changes in land use. The Warren Golf Club, before being relocated to its current location at Choa Chu Kang in 2000, was located at the south-central part of Singapore, between Dover Road and the Ayer Rajah Expressway (AYE). The club site was earmarked for development as an extension of the NUS complex located at Kent Ridge. This new extension, named University Town or UTown was functional by 2011, except for the north-west portion of the site which is now still under construction. As the site is located within one of the Tree Conservation Areas gazetted under the Parks and Trees Act, (Preservation of Trees) Order 1991, trees growing within the site with a girth size of more than one meter are protected by law. In 2012, an unidentified tree at the construction site of UTown was discovered by the developers and was cordoned off by the site managers. A herbarium voucher consisting of a leafy branch with fruits was forwarded to NParks' Streetscape Division, and then on to Singapore Botanic Gardens, for identification. At the Singapore Herbarium (SING) this specimen was matched to *Margaritaria indica* (Dalzell) Airy Shaw which is a new genus and species record for the Singapore flora.

The IUCN conservation status of *Margaritaria indica* is assessed for Singapore based on Davison (2008); and for Peninsular Malaysia using GeoCAT (Bachman et al., 2011), an IUCN Red List (IUCN, 2001) compliant software that generates the IUCN threat categories based on (i) extent of occurrence (EOO) and (ii) area of occurrence (AOO). Data used for the assessment here are based on herbarium records that are represented in SING.

Taxonomic notes on the new record

Margaritaria L.f., Suppl. Pl. 66 (1781); Webster, J. Arnold Arbor. 60: 403 (1979); Webster, Ann. Missouri Bot. Gard. 81: 44 (1994); Barker, Blumea 46: 506 (2001).

The genus is pantropical (excluding the Pacific Islands), with 14 species, of which only two (*Margaritaria indica* and *M. luzoniensis* (Merr.) Airy Shaw) occur in Malesia. Webster (1979) revised the entire genus and Barker (2001) treated the Malesian species. The species are variously found in deciduous forest, dry forest and evergreen forest in the lowlands, as well as on limestone or in riparian vegetation, and also in secondary forests.

Margaritaria species are dioecious. The distichous leaf arrangement, axillary flowers produced singly or in small clusters, four sepals in two series, absence of petals, annular disc and absence of a pistillode in the staminate flower, bifid or bipartite stigmas in the pistillate flower, capsular 3-locular fruits, bluish purple sarcotesta around the seed, and thick bony endotesta, are characteristic features (Webster, 1979; Barker, 2001). It was formerly placed in Euphorbiaceae subfamily Phyllanthoideae Asch. by Webster (1994) and is now in the Phyllanthaceae (APG III, 2009). It is distinguished from *Phyllanthus* L. by its annular (instead of lobed) disc in the staminate flower,

sarcotesta and thick bony endotesta; and from *Flueggea* Willd. by its four (not five) sepals, absence of a pistillode in the staminate flower and sarcotesta.

***Margaritaria indica* (Dalzell) Airy Shaw**

Kew Bull. 20: 398 (1966); Airy Shaw, Kew Bull. 25: 492 (1971); Barker, Blumea 46: 507 (2001). – *Prosorus indicus* Dalzell, Hooker's J. Bot. Kew Gard. Misc. 4: 345 (1852). – *Phyllanthus indicus* (Dalzell) Müll.Arg., Linnaea 32: 52 (1863). – TYPE: India, Deccan, *Dalzell s.n.* (holo K).

Barker (2001) recognised two forms: *Margaritaria indica* f. *indica* is completely glabrous, with leaves drying dark brown, acute to acuminate leaf apices, and slender fruiting pedicels of 0.3 mm diameter (in dried material); and *Margaritaria indica* f. *vestita* (known only from East Java), is sparsely pubescent on at least the pedicels, with leaves drying olive brown, obtuse to rounded leaf apices, and thicker fruiting pedicels c. 1 mm diameter (in dried material). The Singapore material is clearly *Margaritaria indica* f. *indica* (Fig. 1 & Fig. 2).

Below we provide an augmented description of *Margaritaria indica* f. *indica* adapted from Barker (2001) with additional information based on the Singapore collection:

Tree, up to 30 m high with a solitary or multiple trunks, clear trunk height c. 4–15 m, trunk diameter c. 45–80 cm, buttresses absent to a few, c. 1.2 m high, c. 15 cm wide and c. 25 cm thick. **Bark** smooth, finely cracked, or scaly, pale to greyish brown, to red-brown or orange-brown, the bark scales irregularly peeled to give a dippled appearance and exposing newer bark of various shades ranging from fawn to orange-brown; all parts glabrous. **Twigs** generally terete, distal parts somewhat sub-compressed, older portions greyish brown and sometimes peeling to expose newer orange-brown bark, the younger distal parts dark green to reddish brown, densely lenticellate throughout, lenticels elongate, pale grey. **Stipules** triangular to lanceolate, 2–4.5 mm long, scarious, caducous, leaving behind a semi-circular scar on the twig, apex acuminate. **Leaves** alternate; petiole adaxially channelled, 3.5–7(–11) mm long; lamina elliptic to obovate, smaller at the more proximal nodes on a twig, larger more distally, 3–17 × 1.8–8.3 cm, chartaceous, adaxially medium green, abaxially pale green, very slightly glaucous, midrib pale green on both sides, slightly raised above, prominent below, secondary veins 6–12 pairs, distinct on both sides, faintly looped towards the leaf margin, tertiary venation barely visible on both sides, reticulate; apex acute, acuminate to apiculate, base cuneate to rounded, sometimes slightly oblique, very slightly decurrent; margin entire, sometimes slightly undulate. **Staminate flowers** minute, in clusters of 2–28; pedicels up to 7 mm long; inner sepals obovate, 1.2–1.6 × 1–1.4 mm wide; outer sepals ovate, 0.8–1.3 × 0.8–1 mm wide; disc large, flattened, slightly lobed, diameter c. 0.6–1.3 mm; filaments 0.8–1.5 mm long; anthers oblong, 0.7–0.8 mm long. **Pistillate flowers** in clusters of 1–7; pedicels up to 2.2 cm long; inner and outer sepals obovate to oblong, inner sepals c. 1.5–2 × 1–1.8 mm, outer sepals c. 1.5–2 × 1–1.3 mm; disc diameter 1.8–2.6 mm; stigmas spreading, sessile, flat,



Fig. 1. *Margaritaria indica*: a several-stemmed tree with a characteristically scaly-dippled bark with grey-fawn and orange-brown patches. (Photo: P.K.F. Leong)

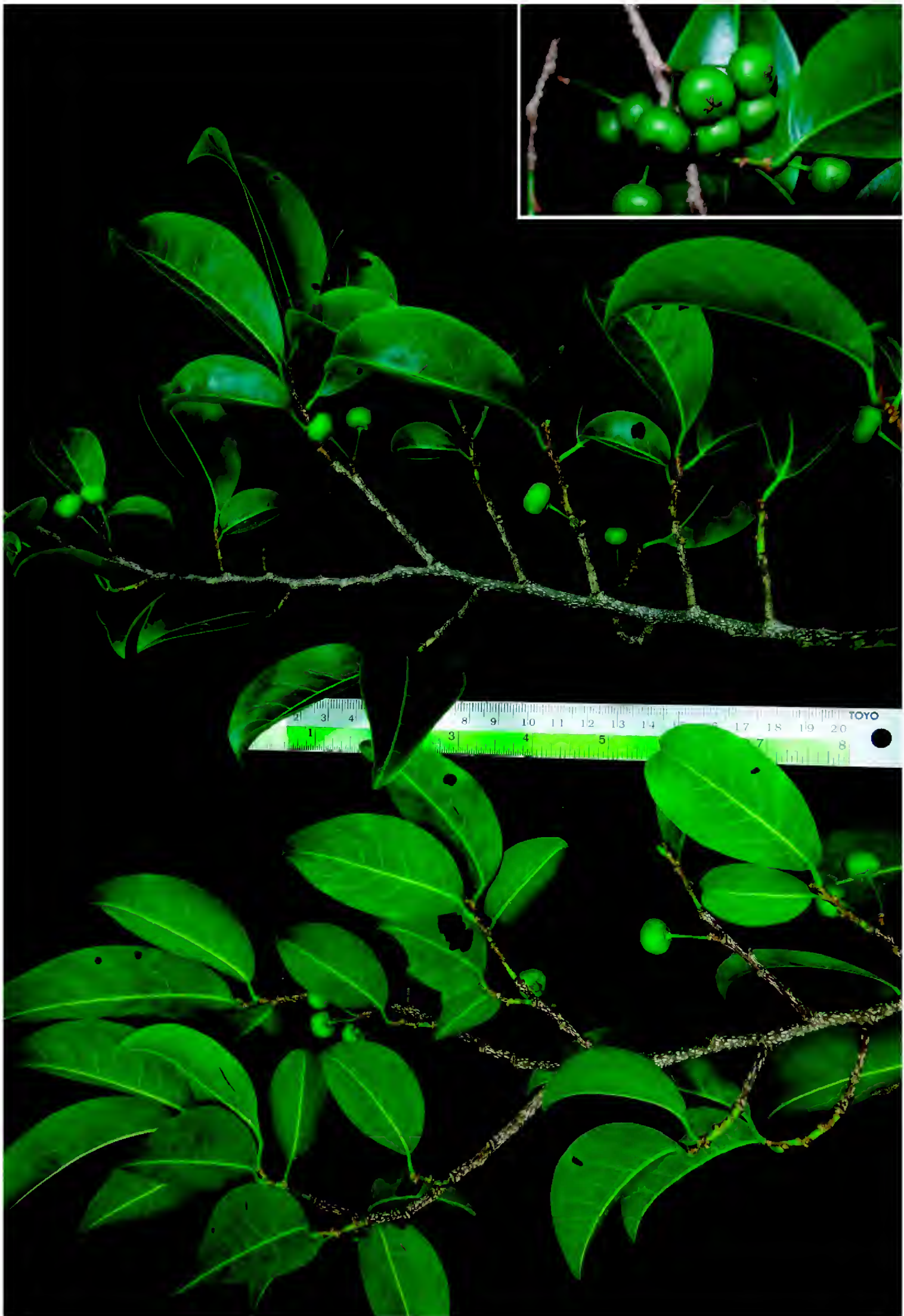


Fig. 2. *Margaritaria indica*: leafy fruiting twigs. (Photo: P.K.F. Leong) *Inset*: Close-up of a cluster of immature tri-locular fruits with conspicuous fine suture running longitudinally along the length of each locule. (Photo: Y.W. Low)

1.5–2 mm long, apically bifid to about a third its length. **Fruits** solitary or in pairs from leaf axils, superior, subglobose, very slightly 3-lobed with a pale fine longitudinal suture along the median of each lobe, (0.6–)0.9–1.2 cm diameter, pale to medium green before maturity, drying ochreous brown; stigmas persistent, columella occasionally persistent; pedicels 0.8–2 cm long, 0.3–1 mm diameter, pale green. **Seeds** (immature) plano-convex, $3.5\text{--}5 \times 2.8\text{--}4$ mm, pale yellowish brown, with a thin translucent bluish purple sarcotesta.

Specimens examined: SINGAPORE. South-central Singapore, between Dover Road and Ayer Rajah Expressway, National University of Singapore, University Town, 29 May 2012, *Leong et al.* SING 2012-252 (SING! barcode no. SING0166292).

PENINSULAR MALAYSIA. **Pahang**. Pulau Berhala, 15 Jun 1932, *Corner s.n.* (SING! barcode no. SING0166291); northwest of Pulau Tioman, Pulau Chibeh, sea level, 19 Aug 1935, *Corner SFN29829* (SING! 2 sheets, barcode nos. SING0166290 & SING0165787). **Johor**. Pulau Sibul, Jun 1992, *sine coll.* P.P. Kumar 101 (SING! 2 sheets, barcode nos. SING0166010 & SING0166011).

Distribution. From India (Deccan plateau), Sri Lanka, through Myanmar, Thailand, northern Vietnam, southern China (SW Guangxi) and Taiwan, across Malesia, to Australia (N Queensland). In Malesia, it has been recorded from Sumatra, Peninsular Malaysia (Chibeh Island, Berhala Island and Sibul Island off the east coast, and not recorded on the mainland) and Singapore (this contribution) (see Fig. 3 for the distribution of *Margaritaria indica* in the Malay Peninsula), Java, Borneo (Sarawak), the Philippines (Luzon, Palawan, Mindanao, Sulu Islands), Lesser Sunda Islands (Sumba), Moluccas (the Sula Islands of Mangoli and Tanimbar), and the Aru Islands.

The distribution of *Margaritaria indica* has been described by Barker (2001) as “rare and very scattered in primary forests, in riverine forests and peat swamps” and also “on limestone...up to 650 m altitude”. Earlier, Webster (1979) remarked: “This widespread species has a curious spotty distribution which perhaps reflects vagaries of collecting.” That the Singapore record has been elusive until now lends some support to the notion that local populations occur at low frequencies. However, the species is indeed generally rare in Malesia, apparently occurring only on the smaller islands or around the coastline on the bigger island of Borneo (see Map 1 showing the distribution in Barker (2001)).

Relationships. The only other congener of *Margaritaria indica* in Malesia is the Philippine *M. luzoniensis*. That species, restricted to Luzon Island, has small leaves up to 4 cm long only, with petioles that are not adaxially channelled, small fruits of 6–8 mm diameter, and a smooth seed endotesta. In contrast, *Margaritaria indica* has larger leaves to 17 cm long, petioles that are adaxially channelled, larger fruits of 9–12 mm diameter, and a rugose seed endotesta (Barker, 2001). The taxa overlap in the Philippines, where Barker (2001) suspects some degree of “intergradation” (introgression) could have taken place, accounting for somewhat intermediate forms.

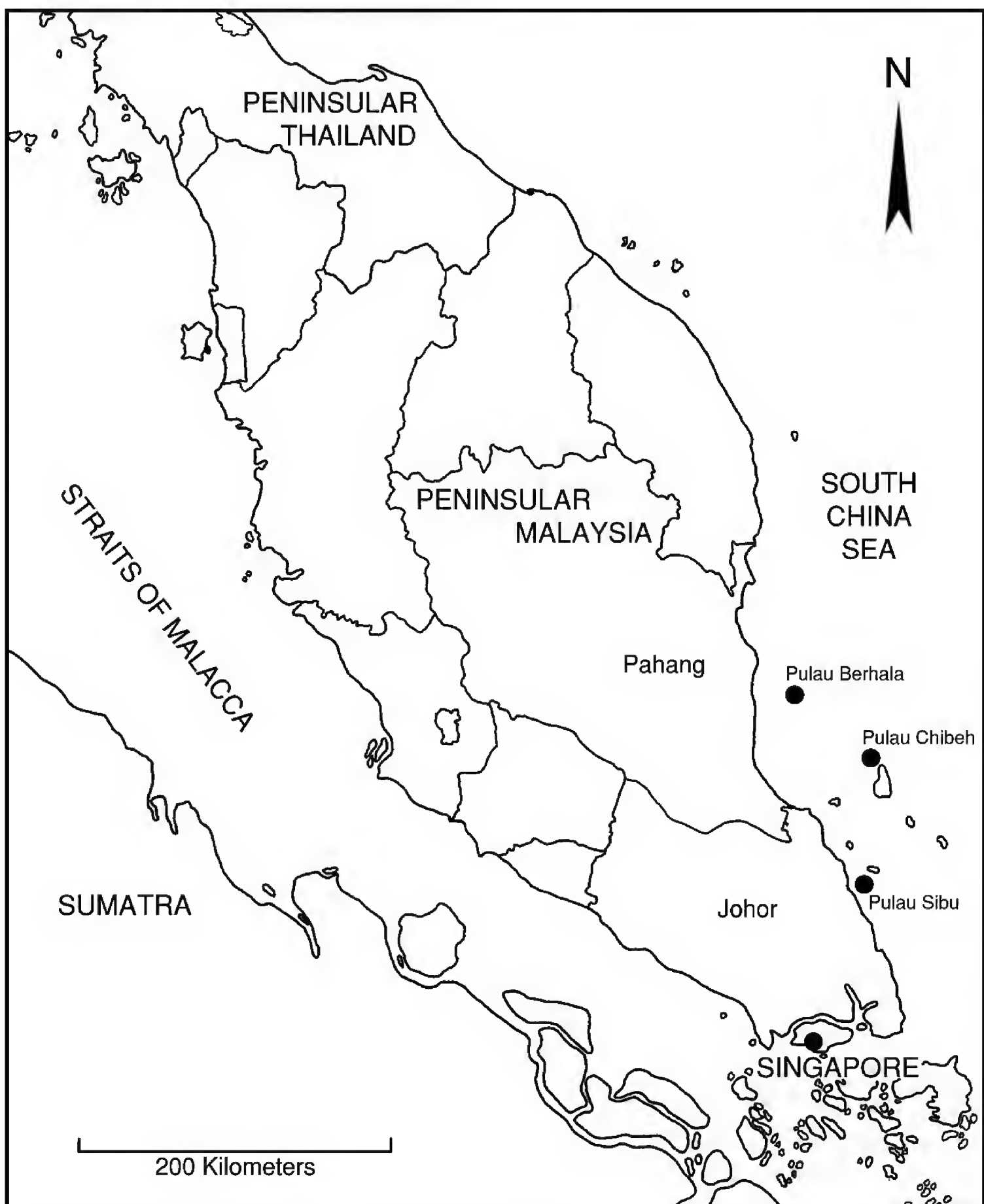


Fig. 3. Distribution of *Margaritaria indica* in the Malay Peninsula, indicated by black dots.

Proposed IUCN Conservation Assessment. The *Margaritaria indica* individual discovered for Singapore is the only one known, hence the national conservation status assessment, based on Davison (2008), is Critically Endangered (CR) with the designation Category D. The category 'D' designation is for fewer than 50 mature

individuals known with some evidence of decline or fragmentation (in fact this is the only mature and living individual known for Singapore).

In contrast, based on all the distribution known for Peninsular Malaysia, the IUCN conservation status assessed using GeoCAT categorised *Margaritaria indica* as Endangered (EN) (IUCN, 2001), with the designation B2ab(iii,iv). The 'B2' designation results from an area of occurrence (AOO) estimated to be less than 500 km² (about 12 km² for *M. indica*); 'a' is due to a severely fragmented distribution and occurrence in three locations, namely, Pulau Berhala and Pulau Chibeh (Pahang), and Pulau Sibul (Johor); and 'b(iii, iv)' considers likely continuing decline in area, extent and quality of habitat, and number of locations. Habitat loss is a major concern for the species especially in Peninsular Malaysia as islands and coastal areas are becoming more disturbed, not free from human activities.

Notes. The earliest records of *Margaritaria indica* for Peninsular Malaysia came from Pulau Berhala and Pulau Chibeh, tiny islands northwest of Tioman Island in the South China Sea, off the eastern Pahang coast. Corner (1985) described Pulau Chibeh as consisting "of immense granite blocks more or less *in situ*, immense fallen boulders, a bare granite face above tide level, and more or less of a submerged talus of boulders and pebbles". He characterised Pulau Berhala as "a flat granite platform, roughly circular, about 400 ft wide, raised a foot or more above sea level and, probably, awash at highest tides or in storms." Corner's collection from Chibeh, *SFN* 29829, was "a frequent small tree on rocks at the top of the island and on the west slope". He described it as resembling the guava-tree (*Psidium*) with slightly papery-flaky bark and collected it as "Aporosa ?" although later in the herbarium Henderson thought it was possibly a species of *Celastrus* (Celastraceae) (Corner, 1985: 15). In his records comparing species distributions among the different islands surveyed (Corner, 1985: 17), Corner recorded this taxon as present in Pulau Chibeh and Pulau Sepoi, but not Pulau Berhala; we cannot explain this apparent discrepancy with the herbarium vouchers available.

The seed sarcotesta is reported to ripen a glistening bluish purple suggesting it would attract bird dispersers (Barker, 2001).

Possible medicinal and economic value. Little is known about the medicinal properties of *Margaritaria indica*, although Burkill (1935) mentioned it as an example (under *Phyllanthus*) of a poisonous taxon, explaining only that medicinal uses of various *Phyllanthus* spp. are "chiefly for external application". Webster (1979) suggests that it is closely related to the African *Margaritaria discoidea*, the healing and anti-inflammatory properties of which are known (Dickson, 2010). Ekuadzi et al. (2013) have demonstrated that flavonoid glycosides from stem bark of *Margaritaria discoidea*, traditionally used in Ghana for the management of skin infections and wounds, helped reduce microbial load in wounds and facilitated healing. Kaaya et al. (1995) found that water soluble extracts of that species induced high mortalities in some ticks; and Cho-Ngwa et al. (2010) showed that such extracts are potential sources of microfilaricidal compounds for the treatment of onchocerciasis, a parasitic disease of man caused by

a filarial worm. Continuing research (Obiri et al., 2014) has found that *Margaritaria discoidea* suppresses allergy and promotes anti-inflammatory responses in mice.

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